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(54) **SNUBBING STACK**

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E21B 19/00 (2006.01)

(52) **U.S. Cl.**
CPC ***E21B 33/068*** (2013.01); ***E21B 19/00*** (2013.01)

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CPC E21B 33/068; E21B 19/00; E21B 19/08; E21B 33/076
USPC 166/77.53, 85.1
See application file for complete search history.

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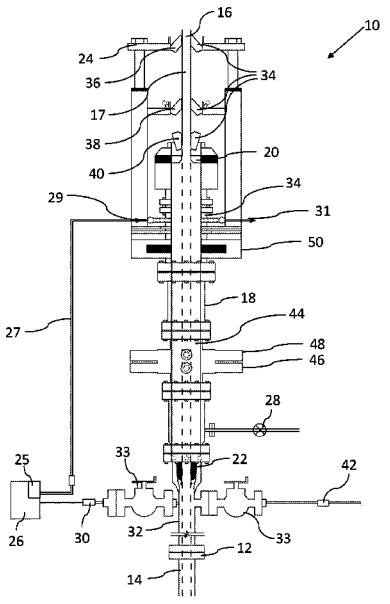
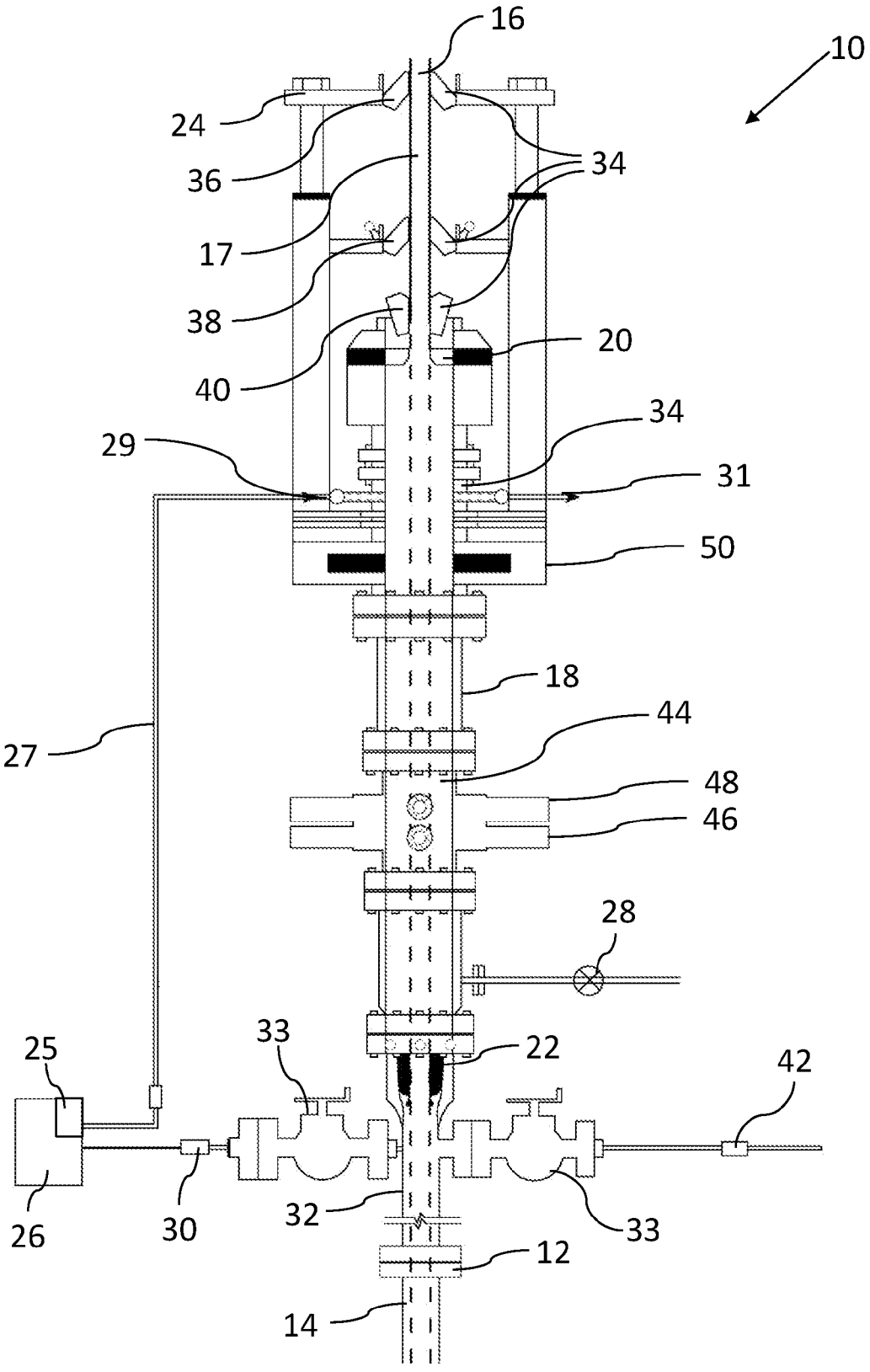
(57) **ABSTRACT**

A snubbing apparatus for a wellhead has a snubbing stack with a upper sealing element and a lower sealing element that seal between the elongate string and the snubbing stack. A string driver carried by the snubbing stack manipulates the elongate string through the upper and lower sealing elements. There is a source of inert liquid connected to the snubbing stack between the upper sealing element and the lower sealing element. A pressure sensor is connected to sense the pressure below the lower sealing element and is connected to provide a pressure signal to the source of inert liquid. The source of inert liquid is configured to pressurize the snubbing stack between the upper sealing element and the lower sealing element in response to the pressure signal.

21 Claims, 1 Drawing Sheet

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SNUBBING STACK

TECHNICAL FIELD

This relates to a snubbing stack used to snub into or out of a pressurized wellhead.

BACKGROUND

When it is necessary to inject or remove a tubing string or other elongate string from a pressurized wellhead, a snubber is used. The wellhead will generally be sealed, such as by a blow-out preventer, and the snubber will either push or pull the tubing through the seal. As such, the snubber allows the pressure to be contained within the wellhead.

SUMMARY

There is provided a snubbing apparatus for a wellbore having a wellhead, an elongate string being inserted into the wellbore through the wellhead. The snubbing apparatus comprises a snubbing stack having a upper sealing element and a lower sealing element, wherein, in operation, the upper and lower sealing elements seal between the elongate string and the snubbing stack. A string driver is carried by the snubbing stack, the string driver manipulating the elongate string through the upper sealing element and the lower sealing element. A source of inert liquid is connected to the snubbing stack between the upper sealing element and the lower sealing element. A pressure sensor is connected to sense the pressure below the lower sealing element and connected to provide a pressure signal to the source of inert liquid, the source of inert liquid being configured to pressurize the snubbing stack between the upper sealing element and the lower sealing element in response to the pressure signal.

According to an aspect, the source of inert liquid may be configured to equalize the pressure between the upper sealing element and the lower sealing element to the pressure below the lower sealing element.

According to an aspect, the snubbing apparatus may further comprise a bleed off valve connected to the snubbing stack between the upper sealing element and the lower sealing element.

According to an aspect, the snubbing stack may comprise a tubing spool that extends below the lower sealing element, and the pressure sensor may be connected to the tubing spool.

According to an aspect, the tubing driver may be snubbing slips.

According to an aspect, the upper sealing element may be an annular blowout preventer.

According to an aspect, the lower sealing element may be a resilient sealing element.

According to an aspect, the lower sealing element may be within a tubing spool.

According to an aspect, there may be a bleed off valve connected below the lower sealing element.

According to an aspect, the source of inert liquid is a liquid pump.

According to an aspect, the inert liquid may be glycol.

According to another aspect, there is provided a method of snubbing an elongate string into a wellbore having a wellhead, the method comprising the steps of: providing a snubbing stack having a upper sealing element and a lower sealing element; inserting the elongate string into the snubbing stack such that the top and lower sealing elements seal between the elongate string and the snubbing stack; driving the elongate string to move through the upper sealing element and the lower sealing element; sensing a wellhead pressure below the lower sealing element; injecting an inert fluid into the snubbing stack; and pressurizing the inert fluid within the snubbing stack based on the wellhead pressure.

According to an aspect, pressurizing the inert fluid may comprise equalizing the pressure to the wellhead pressure.

According to an aspect, injecting an inert fluid into the snubbing jack may further comprise bleeding off fluid within the snubbing stack as the inert fluid is injected.

According to an aspect, the snubbing stack may comprise a spool that extends below the lower sealing element and the pressure is measured by a pressure sensor connected to the spool.

According to an aspect, driving the elongate string may comprise using snubbing slips.

According to an aspect, the upper sealing element may be an annular blowout preventer.

According to an aspect, the lower sealing element may be a resilient sealing element.

According to an aspect, the lower sealing element may be within a spool.

According to an aspect, the inert liquid may be pressurized by a liquid pump connected to a source of inert liquid.

According to an aspect, the inert liquid may be glycol.

Other aspects will be apparent from the description and drawings below. Each of the described aspects may be combined with other aspects except when mutually exclusive.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to be in any way limiting, wherein:

FIG. **1** is a side elevation view of a snubbing stack for a pressurized wellhead.

DETAILED DESCRIPTION

A snubbing apparatus generally identified by reference numeral **10** will now be described with reference to FIG. **1**.

Structure and Relationship of Parts:

The snubbing apparatus **10** is primarily intended for use when servicing high temperature and/or high pressure wells and is designed to help reduce the risk of fire or explosions. The snubbing apparatus **10** as shown in FIG. **1** is mounted to a wellhead **12** generally is mounted above a casing string **14** that extends into a wellbore below the wellhead **12**. An elongate string **16** is inserted into wellhead **12** and casing string **14**. As shown, the elongate string **16** is a tubing string. The following will describe the snubbing apparatus in terms of a tubing string **16**, although it will be understood that elongate string **16** may also be a rod or other elongate string that may be snubbed as known in the art. Snubbing apparatus **10** has a snubbing stack **18** with an upper sealing element **20** and a lower sealing element **22**. The upper sealing element **20** and the lower sealing element **22** seals between the tubing string **16** and the snubbing stack **18**. As shown, upper sealing element **20** is an annular blowout preventer, and lower sealing element **22** is a resilient sealing element. An example of a suitable resilient sealing element is a RS-100 Seal produced by Mitey Titan Industries Inc. of Edmonton, Alberta, although other seals may be produced.

It will be understood that other seals as are known in the art may be used for either the top or bottom seals.

The snubbing stack **18** carries a string driver **24**, which is used to manipulate tubing string **16** through the upper sealing element **20** and the lower sealing element **22**. As shown, tubing driver **24** is snubbing slips **34** used to drive tubing string **16**, although it will be understood that different drivers **24** may be used as are known in the art. Snubbing slips **34** as shown include three types of slips **34**, specifically, travelling slips **36**, stationary slips **38**, and heavy slips **40**. Travelling slips **36** grip tubing string **16** and move it upwards or downwards. Stationary slips **38** grip the tubing string **16** to prevent movement while travelling slips **36** release tubing string **16** while they are repositioned to grip tubing string **16** to again apply force to move tubing string **16**. Heavy slips **40** are generally optional, and are used to bear the weight of tubing string **16** when desirable.

Snubbing stack **18** is designed to be filled with an inert liquid between upper sealing element **20** and lower sealing element **22**. Inert fluid is provided by a source of inert liquid **26** connected by a supply line **27** to a port **29**. The source of inert liquid **26** is configured to pressurize the liquid within snubbing stack **18** between upper sealing element **20** and lower sealing element **22** relative to the wellbore pressure, which as shown is measured by a pressure sensor below lower sealing element **22**. Preferably, the pressure of the liquid is equalized with the pressure in casing string **14**. However, sealing element **22** is designed to withstand some pressure, and the pressure within stack **18** may be slightly lower. On the other hand, to ensure no leakage into stack **18** from casing **14**, the pressure within stack **18** may be equal to or greater than the pressure in casing **14**. The source of inert liquid **26** is, for example, a liquid pump **25**. The inert liquid is pressurized by a liquid pump **25** connected to a source of inert liquid **26**. The inert liquid provided by the source of inert liquid **26** is preferably glycol, although it will be understood that other types of inert liquid may be used, for example, water. Connected to the snubbing stack **18**, there may be a bleed off valve **28** between the upper sealing element **20** and the lower sealing element **22**. As shown, bleed off valve **28** is located at the bottom of snubbing stack **18**, and is intended to be used to drain any fluid in snubbing stack **18** as the inert liquid is pumped in. There may be a second bleed off valve **31** located at the top of snubbing stack **18**. Either or both of these valves **28** and **31** may be used to relieve pressure in snubbing stack **18** between sealing elements **20** and **22**.

Pressure sensor **30** is connected below the lower sealing element **22** and provides a pressure signal to the source of inert liquid **26**. The source of inert liquid **26** pressurizes the snubbing stack **18** between the upper sealing element **20** and the lower sealing element **22** to the desired pressure relative to the pressure within casing **14**. This is preferably done in response to the pressure signal from the pressure sensor **30**. Source **26** may be regulated in various ways. For example, there may be a microcontroller that regulates the pressure. There may also be other mechanical or electrical sensors or switches that control source **26** in response to the pressure within casing string **14**. Pressure sensor **30** allows for the inert fluid to be added into the cavity **44** between the upper sealing element **20** and the lower sealing element **22**, pressurizing the inert fluid within the cavity **44** until the pressure of the inert fluid is equal to the pressure of the wellhead **12**. Pressure sensor **30** may attach to snubbing stack **18** below lower sealing element **22**. In the depicted example, snubbing stack **18** has a tubing spool **32** below lower sealing element **22** that houses lower sealing element **22** and to which pressure sensor **30** is attached. As can be seen, there is a valve, such as a casing valve **33**, between pressure sensor **30** and tubing spool **32**. This is optional, but may be useful, for example to isolate pressure sensor **30** if a problem arises. There may also be a casing bleed off valve **42** connected to tubing spool **32** by another casing valve **33**. This bleed off valve **42** allows downhole fluid pressure to be relieved below lower sealing element **22**.

Snubbing stack **18** may also include other features, such as a blind ram blowout preventer (BOP) **46** and a pipe ram BOP **48** as well as a stripping ram BOP **50**. These BOPs are include for safety purposes to ensure safe operation and to allow the operator to control the well in the event of a failure. Stripping ram BOP **50**, port **29** and bleed off valve **31** may all be carried by an equalizing spool **52**, depending on the preferences of the user.

Operation:

The construction of a well is well known in the art and the downhole assembly will not be discussed in detail. When it is desired to snub a tubing string into or out of a well, snubbing stack **18** is attached to wellhead **12**. Snubbing stack **18** may be as shown in FIG. **1**, or may be any reasonable variation based on the principles described above. During the process of assembling snubbing stack **18**, a rubber insert **22** or other similar sealing element is place in tubing spool **32** in order to form lower sealing element **22**. The pressure sensor **30** installed on tubing spool **32** in the drawings connects to a device that can pump the inert liquid **26** inside the snubbing stack **18**, such as a skid mounted triplex pump, and this device is attached to the pressure sensor **30**.

When placing the snubbing stack **18** with an upper sealing element **20** and a lower sealing element **22**, the tubing string **16** will be inserted such that the upper sealing element **20** and the lower sealing element **22** form a seal about tubing string **16** within snubbing stack **18**. Once properly installed, downhole pressure will be contained below lower sealing element **22**, although snubbing stack **18** may be filled with downhole fluids. Source of inert liquid **26**, such as a pump, is then be turned on and glycol or another inert liquid is added to the cavity **44** formed between upper sealing element **20** and lower sealing element **22**. Casing bleed off valve **42** may be used to allow any well fluids to be drained out of cavity **44**, allowing it to be filled with inert liquid. Source of inert liquid **26** continues to pump liquid until such point as the pressure in this cavity **44** is equal to the pressure in the wellhead **12** below lower sealing element **22** as detected by pressure sensor **30**, or matches some other predetermined pressure relationship as described above. The use of glycol or other inert liquid ensures that, in the event of an equipment or seal failure, the inert liquid will be released prior to the wellbore fluids, allowing operators the opportunity to shut in the well or close a BOP. Once properly installed and arranged, tubing string **14** may be snubbed in or out using string driver **24**.

In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one of the elements.

The scope of the following claims should not be limited by the preferred embodiments set forth in the examples above and in the drawings, but should be given the broadest interpretation consistent with the description as a whole.

What is claimed is:

1. A snubbing apparatus for a wellbore having a wellhead, an elongate string being inserted into the wellbore through the wellhead, the snubbing apparatus comprising:

a snubbing stack having an upper sealing element and a lower sealing element, wherein, in operation, the upper and lower sealing elements seal between the elongate string and the snubbing stack, the lower sealing element sealing the snubbing stack against a wellbore pressure below the lower sealing element;

a string driver carried by the snubbing stack, the string driver manipulating the elongate string through the upper sealing element and the lower sealing element;

a source of inert liquid connected to supply inert liquid to the snubbing stack between the upper sealing element and the lower sealing element; and

a pressure sensor connected to sense the wellbore pressure below the lower sealing element and connected to provide a pressure signal to the source of inert liquid, the source of inert liquid being configured to pressurize the inert liquid in the snubbing stack between the upper sealing element and the lower sealing element in response to the pressure signal.

2. The snubbing apparatus of claim 1, wherein the source of inert liquid is configured to equalize the pressure between the upper sealing element and the lower sealing element to the wellbore pressure below the lower sealing element.

3. The snubbing apparatus of claim 1, further comprising a bleed off valve connected to the snubbing stack between the upper sealing element and the lower sealing element.

4. The snubbing apparatus of claim 1, the snubbing stack comprising a tubing spool that extends below the lower sealing element, the pressure sensor being connected to the tubing spool.

5. The snubbing apparatus of claim 1, wherein the tubing string driver is snubbing slips.

6. The snubbing apparatus of claim 1, wherein the upper sealing element is an annular blowout preventer.

7. The snubbing apparatus of claim 1, wherein the lower sealing element is a resilient sealing element.

8. The snubbing apparatus of claim 1, wherein the lower sealing element is within a tubing spool.

9. The snubbing apparatus of claim 1, further comprising a bleed off valve connected below the lower sealing element.

10. The snubbing apparatus of claim 1, wherein the source of inert liquid is a liquid pump.

11. The snubbing apparatus of claim 1, wherein the inert liquid is glycol.

12. A method of snubbing an elongate string into a wellbore having a wellhead, the method comprising the steps of:

providing a snubbing stack having an upper sealing element and a lower sealing element, the lower sealing element sealing between the snubbing stack and a wellhead pressure below the lower sealing element;

inserting the elongate string into the snubbing stack such that the top and lower sealing elements seal between the elongate string and the snubbing stack;

driving the elongate string to move through the upper sealing element and the lower sealing element;

sensing the wellhead pressure below the lower sealing element;

injecting an inert fluid into the snubbing stack; and

pressurizing the inert fluid within the snubbing stack based on the wellhead pressure.

13. The method of claim 12, wherein pressurizing the inert fluid comprises equalizing the pressure to the wellhead pressure.

14. The method of claim 12, wherein injecting an inert fluid into the snubbing stack further comprises bleeding off fluid within the snubbing stack as the inert fluid is injected.

15. The method of claim 12, wherein the snubbing stack comprises a spool that extends below the lower sealing element and the wellhead pressure is measured by a pressure sensor connected to the spool.

16. The method of claim 12, wherein driving the elongate string comprises using snubbing slips.

17. The method of claim 12, wherein the upper sealing element is an annular blowout preventer.

18. The method of claim 12, wherein the lower sealing element is a resilient sealing element.

19. The method of claim 12, wherein the lower sealing element is within a spool.

20. The method of claim 12, wherein the inert liquid is pressurized by a liquid pump connected to a source of inert liquid.

21. The method of claim 12, wherein the inert liquid is glycol.

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